

### **REMARKS**

This Amendment is responsive to the Office Action dated June 7, 2007. Applicant has amended claims 1-2, 12-13, 20, and 24, and has also added new claim 27. As a result, claims 1-27 are now pending.

### **Information Disclosure Statement**

Applicant acknowledges the Examiner's remarks that the information disclosure statements (IDS's) submitted on 9/27/2004 and 3/24/2005 are in compliance with the provisions of 37 CFR 1.97. Applicant thanks Examiner for considering these submitted IDS's.

Regarding the IDS submitted on 9/27/2004, Applicant acknowledges and agrees with the Examiner's modification to the date of publication of reference number 43, as annotated by the Examiner in the right-hand column. Applicant also acknowledges and agrees with the Examiner's deletion of reference number 31, as it is duplicative of reference number 3. However, regarding reference number 21, the Examiner has specified a modified publication date of April, 2001. Applicant believes that date of publication for this reference number 21, however, has been more generically identified as Quarter 2 (Q2) of 2001 (J.R. Foerster et al., "Ultra-Wideband Technology for Short- or Medium-Range Wireless Communications," Ultra-Wideband Technology for Short- or Medium-Range Wireless Communications, pp. 1-11, Q2 2001).

Regarding the IDS submitted on 3/24/2005, Applicant acknowledges and agrees with the Examiner's modification to the date of publication of reference number 65, as annotated by the Examiner in the right-hand column. Applicant also acknowledges that the Examiner has not considered reference number 82 because it does not specify a date in the IDS. Applicant will re-submit this reference number 82 (P. Withington, "Impulse Radio Overview," Time Domain Corp., pp. 1-7) with a supplemental IDS to accompany the present response.

### **Drawings**

The Examiner objected to the drawings. Applicant submits herewith replacement drawing sheets for FIG. 2 and FIG. 3 in the attached Appendix A. The amendments to the drawings are supported by the original disclosure, and do not introduce any new matter. In view

**AMENDMENTS TO THE DRAWINGS**

Applicant submits herewith replacement drawing sheets for FIG. 2 and FIG. 3. The amendments to the drawings are supported by the original disclosure, and do not introduce any new matter.

of these amendments to the drawings, in addition to the remarks below, Applicant respectfully requests withdrawal of the objections to the drawings.

The Examiner objected to the drawings as failing to comply with 37 CFR 1.84(p)(4) because reference numeral "8" appeared to be used to designate both an overall channel and a channel, and because reference numeral "40" appeared to be used to designate both a rake receiver and one receive antenna. Applicant has amended FIG. 2 to associate the reference numeral "18" with the component labeled "OVERALL CHANNEL". Applicant has amended paragraph [0037] of the specification, as indicated above, to change the phrase "one receive antenna 40" to "a rake receiver 40". In view of these amendments, Applicant requests withdrawal of the objection.

The Examiner further objected to the drawings as failing to comply with 37 CFR 1.84(p)(5) because they do not include the reference numerals "18" and "36", which are both mentioned in the description. As noted above, Applicant has amended FIG. 2 to include the reference numeral "18". In addition, Applicant has amended FIG. 3 to include reference numeral "36", associated with first and second transmit antennas. In view of these amendments, Applicant requests withdrawal of the objection.

The Examiner further objected to the drawings as failing to comply with 37 CFR 1.84(p)(4) because reference numerals "20" and "40" have both been used to designate rake receiver, reference numerals "22" and "42" have both been used to designate MRC unit, and reference numerals "24" and "44" have both been used to designate symbol detector. Applicant respectfully submits, however, that reference numerals "20", "22", and "24", as shown in the example of FIG. 2, are associated with one embodiment of a rake receiver, MRC unit, and symbol detector, respectively, while reference numerals "40", "42", and "44", as shown in the example of FIG. 3, are associated with another embodiment of a rake receiver, MRC unit, and symbol detector, respectively. As noted in the specification, FIG. 3 illustrates a specific example of the system more generally illustrated in FIGS. 1 and 2. Because the cited reference numerals refer to components shown in the embodiments of FIG. 2 and FIG. 3, Applicant respectfully requests withdrawal of this objection.

Applicant has also deleted one of the duplicative reference numerals “6” in FIG. 2. In view of the amendments to the drawings, Applicant respectfully requests withdrawal of the drawing objections.

### **Specification**

The Examiner objected to the disclosure, believing that the recitation of “ $(\mathcal{E} \square \sigma^2)$ ” in paragraph [0035] on page 10, between equations (12) and (13), is improper. The Examiner has required appropriate correction.

As indicated above, Applicant has amended paragraph [0035] with a replacement paragraph. In the amendment, Applicant has replaced the text “ $(\mathcal{E} \square \sigma^2)$ ” with “ $(\rho > \sigma^2)$ ”. This amendment is fully supported by U.S. Provisional Application Serial No. 60/453,810, filed March 8, 2003, to which the present application claims priority. As a result, Applicant requests withdrawal of this objection.

### **Claim Rejection Under 35 U.S.C. § 103**

In the Office Action, the Examiner rejected claims 1-26 under 35 U.S.C. 103(a) as being unpatentable over Alamouti (“A Simple Transmit Diversity Technique for Wireless Communications”, IEEE Journal on Select Areas in Communications, Vol. 16, No. 8, October 1998, pages 1451-1458) in view of Richards (US Patent No. 6,556,621). The Examiner also rejected claims 1 and 12 under 35 U.S.C. 103(a) as being unpatentable over Tarokh et al. (“Space-Time Codes for High Data Rate Wireless Communication: Performance Criterion and Code Construction”, IEEE Transactions on Information Theory, Vol. 44, No. 2, March 1998, pages 744-765) in view of Kolenchery et al. (“A Novel Impulse Radio Network for Tactical Military Wireless Communications”, IEEE MILCOM 1998, Vol. 1, October 18-21, 1998, pages 59-65). Applicant respectfully traverses these rejections. The cited references fail to disclose or suggest the elements recited by Applicant’s claims, as amended, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention(s).

*Independent Claims 1 & 12*

With reference to these independent claims, as amended, the cited references fail to teach or suggest, among other things, processing a stream of information-bearing symbols to form a plurality of symbol blocks, **wherein each symbol block comprises more than one of the information bearing symbols**, and generating multiple **ultra-wideband (UWB) waveforms** from the symbol blocks (wherein each of the UWB waveforms convey the symbols of their respective symbol blocks as pulses repeated over a plurality of frames), and transmitting the UWB waveforms over a plurality of antennas as a space-time coded UWB communication. Neither Alamouti nor Richards, alone or in combination, disclose or suggest processing a stream of information-bearing symbols to form a plurality of symbol blocks, wherein each symbol block comprises more than one of the information bearing symbols. Alamouti describes an encoding and transmission sequence in which, at a given symbol period, two signals are simultaneously transmitted from the two antennas. *Page 1453, Section III(A)*. The signal transmitted from antenna zero is denoted by  $s_0$  and from antenna one by  $s_1$ . *Id.* During the next symbol period, signal  $(-s_1^*)$  is transmitted from antenna zero, and signal  $s_0^*$  is transmitted from antenna one, where  $*$  is a complex conjugate operation. *Id.* Therefore, Applicant submits that Alamouti fails to disclose or suggest processing a stream of information-bearing symbols to form a plurality of symbol blocks, **wherein each symbol block comprises more than one of the information bearing symbols**. Richards does not overcome the shortcomings of Alamouti in this respect.

In addition, the Examiner has conceded that Alamouti fails to specifically disclose waveforms that are ultra-wideband (UWB) waveforms or communication that is UWB communication. Applicant respectfully submits that Richards fails to overcome the shortcomings of Alamouti in this respect, as well. Although Richards may disclose UWB communication in general, Richards does not appear to disclose or suggest generating **multiple** ultra-wideband (UWB) waveforms from symbol blocks that each comprise more than one symbol, and **transmitting the UWB waveforms over a plurality of antennas as a space-time coded UWB communication**. As stated in paragraph [0007] of the present application, “[t]he ST coding techniques provide effective means of enabling spatial diversity, and thus increasing channel performance and capacity within the UWB system.” Paragraph [0009] of the present application further states that “[a]dding one or more transmit antennas to a conventional UWB

communication system with one transmit antenna and one receive antenna increases the diversity order compared to the diversity collected in the conventional UWB system.” Therefore, the combination of the space-time (ST) coding techniques and multiple transmit antennas, as recited in claims 1 and 12, provides certain advantages and benefits. Furthermore, due to the complexities of implementing the claimed inventions with UWB waveforms and UWB communication, as described in the present application, Applicant submits that it would not have been obvious to a person of ordinary skill in the art, at the time of invention, to combine the teachings of Alamouti and Richards or to arrive at the claimed invention.

Similarly, neither Tarokh nor Kolenchery, alone or in combination, disclose or suggest processing a stream of information-bearing symbols to form a plurality of symbol blocks, wherein each symbol block comprises more than one of the information bearing symbols. Tarokh generally describes data that is encoded by a channel code and encoded data that is split into ‘n’ streams that are simultaneously transmitted using ‘n’ transmit antennas. *Abstract*. In Tarokh, a given signal  $c_i^1$  is transmitted from different antennas at a transmission period T. *Section II(a), page 747*. Applicant submits, however, that Tarokh fails to disclose or suggest processing a stream of information-bearing symbols to form a plurality of symbol blocks, **wherein each symbol block comprises more than one of the information bearing symbols**. Kolenchery does not overcome the shortcomings of Tarokh in this respect.

In addition, the Examiner has conceded that Tarokh does not specifically disclose waveforms that are ultra-wideband (UWB) waveforms or communication that is UWB communication. Applicant respectfully submits that Kolenchery fails to overcome the shortcomings of Tarokh in this respect, as well. Although Kolenchery may disclose UWB communication in general, Kolenchery, similar to Richards, does not appear to disclose or suggest generating multiple ultra-wideband (UWB) waveforms from symbol blocks that each comprise more than one symbol, and **transmitting the UWB waveforms over a plurality of antennas as a space-time coded UWB communication**. Similar to the arguments outlined above with regard to Richards, Applicant submits that it would not have been obvious to a person of ordinary skill in the art, at the time of invention, to combine the teachings of Tarokh and Kolenchery.

As a result, for at least these reasons, Applicant respectfully requests reconsideration and allowance of independent claims 1 and 12, as amended.

*Dependent Claims 3 & 14*

Claims 3 and claim 14 depend directly on independent claims 1 and 12, respectively. For at least the reasons outlined above with reference to these independent claims, Applicant submits that dependent claims 3 and 14 are patentable over the cited references. In addition, Applicant further submits that the cited references fail to teach or disclose parsing a stream of symbols into blocks of symbol pairs, where one symbol pair has a first order and a second symbol pair has a second order opposite from the first order. The cited references do not appear to disclose or suggest the processing of these types of claimed symbol pairs. For example, as noted above, Alamouti discloses a signal  $s_0$  transmitted from antenna zero and a signal  $s_1$  transmitted from antenna one during a first symbol period, and a signal  $(-s_1^*)$  transmitted from antenna zero and a signal  $s_0^*$  transmitted from antenna one during the next symbol period, where  $*$  is a complex conjugate operation. *Page 1453, Section III(A)*. As such, Applicant respectfully requests reconsideration and allowance of dependent claims 3 and 14.

*Dependent Claims 4 & 27*

Claims 4 and claim 27 depend directly on independent claims 1 and 12, respectively. For at least the reasons outlined above with reference to these independent claims, Applicant submits that dependent claims 4 and 27 are patentable over the cited references. In addition, Applicant further submits that the cited references fail to disclose or suggest parsing a stream into a first block of symbols while maintaining an order of the stream of symbols, and permuting the symbols of the first block to form a second block in which the symbols are in an order different from the order of the stream of symbols. The cited references do not appear to disclose or suggest these acts of parsing and permuting. For example, as noted above, Alamouti discloses a signal  $s_0$  transmitted from antenna zero and a signal  $s_1$  transmitted from antenna one during a first symbol period, and a signal  $(-s_1^*)$  transmitted from antenna zero and a signal  $s_0^*$  transmitted from antenna one during the next symbol period, where  $*$  is a complex conjugate operation.

*Page 1453, Section III(A).* As such, Applicant respectfully requests reconsideration and allowance of dependent claims 4 and 27.

*Dependent Claims 5-11 & 15-19*

Claims 5-11 depend, either directly or indirectly, on claim 1. Claims 15-19 depend directly on claim 12. Therefore, for at least the reasons outlined above with reference to independent claims 1 and 12, Applicant submits that these dependent claims are patentable over the cited art, and requests reconsideration and allowance of these claims.

*Independent Claims 2 & 13*

Applicant has amended claims 2 and 13 into independent form. In the Office Action, the Examiner stated that Alamouti discloses the subject matter previously recited in dependent claims 2 and 13, and that which is now currently recited in amended claims 2 and 13, as well. Applicant respectfully disagrees. As amended, independent claims 2 and 13 recite, among other things, **duplication of each symbol** to form a first symbol block and a second symbol block **(each comprising the same information bearing symbol)**, and generation of a first UWB waveform from the first symbol block and a second UWB signal from the second symbol block **for simultaneous transmission via a plurality of antennas**. Alamouti fails to disclose or suggest at least these elements of the claims. Table 1 of Alamouti, on page 1454, shows an encoding and transmission sequence for the disclosed transmit delivery scheme. As shown in this table, at “time  $t$ ”, antenna 0 transmits signal  $s_0$  while antenna 1 transmits signal  $s_1$ . At a later time, “time  $t + T$ ”, antenna 0 transmits signal  $(-s_1^*)$  while antenna 1 transmits signal  $s_0^*$ , wherein  $*$  is the complex conjugate operation. Thus, at any given time, Alamouti discloses transmitting different signal waveforms. In fact, because, in Alamouti, different signals are transmitted at “time  $t$ ”, and then complex conjugate operations are performed on these different signals, which are then transmitted on different antennas at “time  $t + T$ ”, Alamouti appears to teach away from duplication of each symbol to form a first symbol block and a second symbol block (each comprising the same information bearing symbol), and generation of a first UWB waveform from the first symbol block and a second UWB signal from the second symbol block for



**simultaneous** transmission via a plurality of antennas. As a result, Applicant respectfully requests reconsideration and allowance of these claims.

*Independent Claims 20 & 24*

Applicant has amended independent claims 20 and 24. With reference to these independent claims, as amended, the cited references fail to teach or suggest receipt of a plurality of space-time (ST) encoded **ultra wideband (UWB) waveforms through a wireless communication channel**, each ST encoded UWB waveform having a **plurality of information-bearing symbols within a symbol block** that are conveyed as pulses repeated over a plurality of frames. For at least reasons similar to those outlined above with reference to independent claims 1 and 12, Applicant submits that neither Alamouti nor Richards, alone or in combination, fail to disclose or suggest each and every element of these claims. Therefore, Applicant respectfully requests reconsideration and allowance of these claims, as amended.

*Dependent Claims 21-23 & 25-26*

Claims 21-23 depend directly on claim 20. Claims 25-26 depend, either directly or indirectly, on claim 24. Therefore, for at least the reasons outlined above with reference to independent claims 20 and 24, Applicant submits that these dependent claims are patentable over the cited art, and requests reconsideration and allowance of these claims.

For at least the reasons outlined above, the Examiner has failed to establish a prima facie case for non-patentability of Applicant's claims 1-26 under 35 U.S.C. 103(a). Withdrawal of this rejection is requested.

**New Claim**

Applicant has added new independent claim 27. This new claim is fully supported by the original disclosure, and does not introduce any new subject matter. In view of the remarks outlined above, Applicant respectfully requests consideration and allowance of this new claim.

### CONCLUSION

All claims in this application are in condition for allowance. Applicant respectfully requests reconsideration and prompt allowance of all pending claims. Although Applicant has focused the arguments above on specific claims, Applicant does not acquiesce to any of the rejections of dependent claims that are not specifically discussed. Applicant reserves further comment on any such claims, but reserves the right to present additional arguments on any of the pending claims. Please charge any additional fees or credit any overpayment to deposit account number 50-1778. The Examiner is invited to telephone the below-signed attorney to discuss this application.

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